

The Examiner rejected claims 1-3, 6, 20, 21, 23, 31, 33, 35, and 36 under 35 U.S.C. §103(a) as allegedly being unpatentable over Yamamoto et al. (EP 0544915 A1, hereinafter "Yamamoto").

The Examiner rejected claim 4 under 35 U.S.C. §103(a) as allegedly being unpatentable over Yamamoto in view of Gundotra et al. (US Patent 5369880, hereinafter "Gundotra").

The Examiner rejected claims 7-10, 12-19, 24-28, 30, 32, and 34 under 35 U.S.C. §103(a) as allegedly being unpatentable over Yamamoto, in view of Yamashita et al. (US Patent 6179935, hereinafter "Yamashita").

The Examiner rejected claims 5, 18, 22, and 29 under 35 U.S.C. §103(a) as allegedly being unpatentable over Yamamoto or Yamamoto and Yamashita, in view of Behlen et al. (US Patent 5598033, hereinafter "Behlen").

Applicants respectfully traverse the final office action and the §103 rejections with the following arguments.

35 U.S.C. §103: Yamamoto

The Examiner rejected claims 1-3, 6, 20, 21, 23, 31, 33, 35, and 36 under 35 U.S.C. §103(a) as allegedly being unpatentable over Yamamoto et al. (EP 0544915 A1, hereinafter "Yamamoto").

Applicants respectfully contend that claims 1 and 20 are not unpatentable under 35 U.S.C. §103(a) over Yamamoto, because Yamamoto does not teach or suggest each and every feature of claims 1 and 20.

As a first example of why Yamamoto does not teach or suggest each and every feature of claims 1 and 20, Yamamoto does not teach: "soldering a lead-free solder member to the substrate without using a joining solder to effectuate the soldering"(claim 1) and "a lead-free solder member soldered to the substrate with no joining solder between the solder member and the substrate" (claim 20), (emphasis added).

The Examiner argues: "Referring to Figs. 4A-8 and related text, discloses Yamamoto discloses a method for forming an electronic structure and inherently the structure formed by the method, the method comprising the steps of providing a substrate 50; and soldering a lead-free solder member to the substrate without using a joining solder to effectuate the soldering (see page 5, lines 5-14)".

In response to the preceding argument by the Examiner, Applicants respectfully contend that page 5, lines 5-14 of Yamamoto does not teach or suggest that the solder member 56 is lead-free as required by claims 1 and 20. The only required property of the solder member 56 is that the solder member 56 must be a **high-temperature** solder (i.e., the solder has a melting

temperature of 240°C - 330°C). See Yamamoto, page 7, line 15. In fact, Yamamoto discloses embodiments in which the high-temperature solder includes substantial amounts of lead (i.e., 85% or more by weight). See Yamamoto, page 7, line 25-26.

Applicants acknowledge that Yamamoto also discloses a high-temperature solder that “includes ... Sn-Sb solder containing 15% by weight of Sb (antimony) or less” (emphasis added). Yamamoto, page 7, lines 24-27. Note that Yamamoto does not state a weight percent of tin in the Sn-Sb solder and Yamamoto does not teach or suggest that the weight percents of tin and antimony add up to 100% or nearly 100%. The use of the open-ended language “includes” and “containing” in Yamamoto’s description of the Sn-Sb solder conveys an intent not to limit the high-temperature solder to only tin and antimony. Since Yamamoto contemplates that the Sn-Sb solder is not limited to tin and antimony, and since Yamamoto does not specifically teach or suggest that the high-temperature solder is lead-free, and since Yamamoto specifically teaches use of a high-temperature solder having at least 85% lead by weight, Applicants respectfully contend that Yamamoto does not teach or suggest that the Sn-Sb solder is lead-free. Thus, Applicants assert that Yamamoto does not teach or suggest that the solder member of claims 1 and 20 is lead free. Accordingly, Applicants contend that the Examiner has not established a *prima facie* case of obviousness in relation to claims 1 and 20.

As a second example of why Yamamoto does not teach or suggest each and every feature of claims 1 and 20, Yamamoto does not teach or suggest “wherein the solder member consists essentially of a tin-antimony alloy, and wherein the tin-antimony alloy consists of about 3% to about 15% antimony by weight and a remainder consisting essentially of tin by weight”

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(emphasis added).

The Examiner argues: "Referring to Figs. 4A-8 and related text, ... the solder member consists essentially a tin-antimony alloy, and wherein the tin-antimony alloy consists of about 15% antimony by weight or less and a remainder consisting essentially of tin by weight (See page 7, lines 24-28)."

In response to the precoding argument by the Examiner, Applicants respectfully contend that the exact language in page 7, lines 24-28 of Yamamoto is: "The high-temperature solder used in the present invention **includes** ... Sn-Sb solder **containing** 15% by weight of Sb (antimony) or less" (emphasis added). Applicants contend that Yamamoto uses the open-ended word "includes" which does not satisfy the more limiting language of "consists essentially of" in the feature "wherein the solder member consists essentially of a tin-antimony alloy" in claims 1 and 20. Applicants further contend that Yamamoto uses the open-ended word "containing" which does not satisfy the more limiting language of "consisting essentially of" in the feature "wherein the tin-antimony alloy consists of about 3% to about 15% antimony by weight and a remainder consisting essentially of tin by weight" in claims 1 and 20. See MPEP 2111.03, which states:

"The transitional term "comprising", which is synonymous with "including," "containing," or "characterized by," is inclusive or open-ended and does not exclude additional, unrecited elements or method steps. See, e.g., *Genentech, Inc. v. Chiron Corp.*, 112 F.3d 495, 501, 42 USPQ2d 1608, 1613 (Fed. Cir. 1997) ("Comprising" is a term of art used in claim language which means that the named elements are essential, but other elements may be added and still form a construct within the scope of the claim.);

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Moleculon Research Corp. v. CBS, Inc., 793 F.2d 1261, 229 USPQ 805 (Fed. Cir. 1986); *In re Baxter*, 656 F.2d 679, 686, 210 USPQ 795, 803 (CCPA 1981); *Ex parte Davis*, 80 USPQ 448, 450 (Bd. App. 1948) ("comprising" leaves "the claim open for the inclusion of unspecified ingredients even in major amounts")."

The meaning of "consisting essentially of" is defined in MPEP 2111.03 which states: "The transitional phrase "consisting essentially of" limits the scope of a claim to the specified materials or steps "and those that do not materially affect the basic and novel characteristic(s)" of the claimed invention (citing *In re Her*, 537 F.2d 549, 551-52, 190 USPQ 461, 463 (CCPA 1976)).

In "Response to Amendment", the Examiner argues that "the use of "consists essentially" allows for the inclusion of additional materials that do not materially affect the basic and novel characteristics. In *Yamamoto* the solder is Sn-Sb, this implies that any additional material included in the Sn-Sb solder would not materially affect the basic and novel characteristic of Sn-Sb.... [The] basic characteristic (functions as a solder) and the novel characteristic (lead free) of the disclosed Sn-Sb solder are not effected by additions of other materials. ... 'Applicant has the burden of showing that the introduction of additional steps or components would materially change the characteristics of applicant's invention'. Besides, 'For the purposes of searching for and applying prior art under 35 U.S.C. 102 and 103, absent a clear indication in the specification or claims of what the basic and novel characteristics actually are, "consisting essentially of" will be construed as equivalent to "comprising." (See MPEP 2111.03)."

In response, Applicants note that the preceding argument by the Examiner has identified lead-free solder as a novel characteristic of the claimed invention, which demonstrates that any addition of lead to the Sn-Sb solder disclosed by Yamamoto would materially change the novel characteristics of the claimed invention. Thus, Applicants have satisfied Applicants' "burden of showing that the introduction of additional steps or components would materially change the characteristics of applicant's invention'."

The Examiner's identification of lead-free solder as a novel characteristic of the claimed invention also provides "a clear indication in the specification or claims of what the basic and novel characteristics actually are", so that "consisting essentially of" will not be construed as equivalent to "comprising". Since "consisting essentially of" will not be construed as equivalent to "comprising", Applicants respectfully maintain that claims 1 and 20 do not read on Yamamoto.

Although the preceding argument establishes that claims 1 and 20 do not read on Yamamoto, Applicants reiterate Applicants' discussion *supra* in conjunction with the first example of why Yamamoto does not teach or suggest each and every feature of claims 1 and 20, As explained *supra*, the use of the open-ended language "includes" and "containing" conveys an intent not to limit the high-temperature solder to only tin and antimony. Since Yamamoto contemplates that the Sn-Sb solder is not limited to tin and antimony, and since Yamamoto does not specifically teach or suggest that the high-temperature solder is lead-free, and since Yamamoto specifically teaches use of a high-temperature solder having at least 85% lead by weight, Applicants respectfully contend that Yamamoto does not teach or suggest that the Sn-Sb solder is lead-free. Thus, Applicants assert that Yamamoto does not teach or suggest that the

solder member of claims 1 and 20 is lead free, which means that the "consisting essentially of" language in claims 1 and 20 distinguishes Yamamoto. Accordingly, Applicants contend that the Examiner has not established a *prima facie* case of obviousness in relation to claims 1 and 20.

Based on the preceding arguments, Applicants respectfully maintain that claims 1 and 20 are not unpatentable over Yamamoto, and that claims 1 and 20 are in condition for allowance. Since claims 2-6, 31, and 35 depend from claim 1, Applicants contend that claims 2-6, 31, and 35 are likewise in condition for allowance. Since claims 21-23, 33 and 36 depend from claim 20, Applicants contend that claims 21-23, 33 and 36 are likewise in condition for allowance.

Additionally as to claims 6 and 23, the Examiner alleges that Yamamoto discloses on page 7, lines 10-17 that the substrate includes a semiconductor chip. In response, Applicants note that Yamamoto, page 7, lines 10-17 discloses only that the substrate includes semiconductor elements. A semiconductor element is not necessarily a semiconductor chip. For example, the semiconductor elements disclosed by Yamamoto may be no more than silicon regions, which are not semiconductor chips. Note that a semiconductor chip is a "single substrate on which all the active and passive circuit elements have been fabricated using one or all of the semiconductor techniques of diffusion, passivation, masking, photoresist, and epitaxial growth. See Modern Dictionary of Electronics 154 (6th ed. 1997). Thus, Applicants contend that the Examiner's argument is not persuasive in relation to claims 6 and 23.

Additionally as to claim 31 which claims that the solder member is a solder ball,

Applicants contend that Yamamoto does not disclose a process capable of soldering a solder ball to the substrate. On page 11, lines 1-19, Yamamoto discloses two alternative processes for forming the solder projection 56. The first process for forming the solder projection 56 uses a flow method deposit high-temperature molten solder on the substrate to subsequently form the solder projection 56. In said flow method, no solder ball is soldered to the substrate since no solder member exists until after all of the molten solder has been deposited on the substrate, i.e., the shapeless molten solder being deposited on the substrate does not have the geometry of a solder ball. Note that the language of claim 1 (from which claim 31 depends) requires that the solder ball exist prior to the soldering of the solder ball to the substrate; i.e., it is physically impossible to solder a non-existent solder ball to a substrate.

The second process for forming the solder projection 56 uses a reflow method in which solder paste is screened or dispensed onto the substrate and then reflowed to subsequently form the solder projection 56. In order to satisfy claim 31, the solder paste on the substrate prior to being reflowed would have to be construed as a solder ball. Applicants contend that said solder paste is a blob of solder paste which cannot be construed as having the geometry of a solder ball. Therefore, if the blob of solder paste on the substrate is not a solder ball, then it follows that said reflow method of Yamamoto does not solder a solder ball to the substrate, as required by claim 1.

The Examiner refers to FIGS. 4A-12 of Yamamoto as allegedly disclosing the solder member as a solder ball. Applicants contend, however, that FIGS. 4A-12 of Yamamoto show the projection 56 after being formed on the substrate 50. Prior to being formed as a solder ball, either molten solder is deposited on the substrate (which does not have the geometrical shape of a solder ball and which does not constitute soldering a solder ball to the substrate) or a blob of

solder is screened or dispensed to the substrate 50, and the blob of solder does not have the geometrical shape of a solder ball. Thus, Yamamoto's flow and reflow processes is incapable of soldering a solder ball to the substrate, since no solder ball exists prior to or during the flow process or reflow process. The solder ball in FIGS. 4A-12 of Yamamoto exists only after the flow or reflow process has been completed. Thus, Applicants respectfully contend that claim 31 is not obvious over Yamamoto.

35 U.S.C. §103: Yamamoto In View Of Gundotra

The Examiner rejected claim 4 under 35 U.S.C. §103(a) as allegedly being unpatentable over Yamamoto in view of Gundotra et al. (US Patent 5369880, hereinafter "Gundotra").

Applicants respectfully contend that Yamamoto in view of Gundotra does not teach or suggest the feature: "wherein the soldering step reduces a height of the solder member between about 25% and about 30%".

The Examiner admits that Yamamoto does not disclose the preceding feature of claim 4. The Examiner alleges that Gundotra disclose the preceding feature of claim 4. The Examiner argues: "A person of ordinary skill is motivated to modify Yamamoto with Gundotra to obtain the desired height reduction appropriate for a specific application."

In response, Applicants respectfully contend that the preceding argument by the Examiner is vague and indefinite and thus not persuasive. The Examiner has not provided any unambiguous reason why one of ordinary skill in the art would find it obvious to modify Yamamoto's invention by Gundotra's teaching. Accordingly, Applicants contend that the Examiner has not established a *prima facie* case of obviousness in relation to claim 4.

35 U.S.C. §103: Yamamoto In View Of Yamashita

The Examiner rejected claims 7-10, 12-19, 24-28, 30, 32, and 34 under 35 U.S.C. §103(a) as being unpatentable over Yamamoto in view of Yamashita et al. (US Patent 6179935, hereinafter "Yamashita").

Applicants respectfully contend that claims 7 and 24 are not unpatentable over Yamamoto in view of Yamashita, based on the same arguments presented *supra* in relation to claims 1 and 20.

In addition with respect to claims 7 and 24, Applicants contend that Yamamoto in view of Yamashita does not teach or suggest the feature: "soldering the solder member to the second substrate with a lead-free joiner solder" (claim 7) and "wherein the solder member is soldered to the second substrate with a lead-free joiner solder" (claim 24), (emphasis added)..

The Examiner admits that the joiner compound that solders the solder member to the second substrate is not lead-free. The Examiner alleges that Yamashita discloses a lead-free joiner compound in the paragraph bridging columns 9 and 10. The Examiner argues: "A person of ordinary skill is motivated to modify Yamamoto with Yamashita to obtain the connection of desired characteristics appropriate for a specific application."

In response, Applicants respectfully contend that the preceding argument by the Examiner is vague and indefinite and thus not persuasive. The Examiner has not provided any unambiguous reason why one of ordinary skill in the art would find it obvious to modify Yamamoto's invention by Gundotra's teaching of the lead-free alloy. In fact, Yamamoto teaches away from use of said lead-free joiner compound by requiring "regular solder (60 Sn/40Pb solder

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having a melting point of 183° - 188°C)" which contains 40% lead. Accordingly, Applicants contend that the Examiner has not established a *prima facie* case of obviousness in relation to claims 7 and 24.

Based on the preceding arguments, Applicants respectfully maintain that claims 7 and 24 are not unpatentable over Yamamoto in view of Yamashita, and that claims 7 and 24 are in condition for allowance. Since claims 8-19 and 32 depend from claim 7, Applicants contend that claims 8-19 and 32 are likewise in condition for allowance. Since claims 25-30 and 34 depend from claim 24, Applicants contend that claims 25-30 and 34 are likewise in condition for allowance.

In addition with respect to claims 12 and 28, Applicants respectfully maintain that Yamamoto in view of Yamashita does not teach or suggest the feature: "wherein the tin-silver-copper alloy consists essentially of by weight about 95.5-96.0% tin, about 3.5-4.0% silver, and about 0.5-1.0% copper." The Examiner alleges that Yamashita discloses the preceding feature in the paragraph bridging columns 9 and 10. The Examiner argues: "A person of ordinary skill is motivated to modify Yamamoto with Yamashita to obtain the connection of desired characteristics appropriate for a specific application."

In response, Applicants respectfully contend that Yamashita does not satisfy the preceding feature, because the paragraph bridging columns 9 and 10 of Yamashita does not disclose that the tin-silver-copper-nickel-germanium-phosphorus alloy includes 95.5%-96.0% tin. Also, the paragraph bridging columns 9 and 10 of Yamashita does not disclose the "consists essentially of" language of claims 12 and 28, since Yamashita's alloy includes Ni, Ge, and P in

addition to tin, silver, and copper.

In addition, the preceding argument by the Examiner in relation to claims 12 and 28 is vague and indefinite and thus not persuasive. The Examiner has not provided any unambiguous reason why one of ordinary skill in the art would find it obvious to modify Yamamoto's invention by Gundotra's teaching of the tin-silver-copper-nickel-germanium-phosphorus alloy. In fact, Yamamoto teaches away from use of said tin-silver-copper-nickel-germanium-phosphorus joiner compound by requiring "regular solder (60 Sn/40Pb solder having a melting point of 183° - 188°C)". Accordingly, Applicants contend that the Examiner has not established a *prima facie* case of obviousness in relation to claims 12 and 28.

In addition with respect to claims 25 and 30, Applicants respectfully maintain that Yamamoto in view of Yamashita does not teach or suggest the feature: "wherein the first substrate includes a semiconductor chip", based on the same reasons presented *supra* in relation to claims 6 and 23.

In addition claims 14-15 and 26 recite the features: "wherein the step of soldering the solder member to the second substrate includes melting the solder member" (claim 14), "wherein the step of soldering the solder member to the second substrate includes intermixing the tin-antimony alloy with the joiner solder" (claim 15); and "wherein the tin-antimony alloy is intermixed with the joiner solder" (claim 26). Applicants contend, however, that the preceding features cannot be incorporated into Yamamoto, because Yamamoto requires a high-temperature solder that is not melted and is thus not intermixed with the joiner compound when the solder

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member is soldered to the second substrate. See Yamamoto, col 11, lines 21-26; col. 13 lines 1-5 (i.e., claim 15); col. 5, lines 15-16. Indeed, Yamamoto explains in page 5, lines 14-24 why the high-temperature solder is not melted and is thus not intermixed with the joiner compound when the solder member is soldered to the second substrate. Accordingly, Applicants contend that claims 14-15 and 26 are not unpatentable over Yamamoto in view of Yamashita.

In addition with respect to claim 32, Applicants respectfully maintain that Yamamoto in view of Yamashita does not teach or suggest the feature: "wherein the solder member is a solder ball" based on the same reasons presented *supra* in relation to claim 31

35 U.S.C. §103: Yamamoto or Yamamoto and Yamashita In View Of Behlen

The Examiner rejected claims 5, 18, 22, and 29 under 35 U.S.C. §103(a) as allegedly being unpatentable over Yamamoto or Yamamoto and Yamashita, in view of Behlen et al. (US Patent 5598033).

Since claim 5 depend from claim 1, which Applicants have argued *supra* to be patentable under 35 U.S.C. §103(a), Applicants maintain that claim 5 is not unpatentable under 35 U.S.C. §103(a).

Since claim 18 depend from claim 7, which Applicants have argued *supra* to be patentable under 35 U.S.C. §103(a), Applicants maintain that claim 18 is not unpatentable under 35 U.S.C. §103(a).

Since claim 22 depend from claim 20, which Applicants have argued *supra* to be patentable under 35 U.S.C. §103(a), Applicants maintain that claim 20 is not unpatentable under 35 U.S.C. §103(a).

Since claim 29 depend from claim 24, which Applicants have argued *supra* to be patentable under 35 U.S.C. §103(a), Applicants maintain that claim 29 is not unpatentable under 35 U.S.C. §103(a).

In addition, the Examiner alleges that "Behlen discloses CBGA and PGCA are common type of electronic package". The Examiner argues: "A person of ordinary skill is motivated to modify Yamamoto or Yamamoto and Yamashita with Behlen to obtain the desired package appropriate for a specific application. Therefore, it would have been obvious to combine Yamamoto or Yamamoto and Yamashita with Behlen to obtain the invention as specified in

claims 5, 18, 22, and 29."

In response, Applicants respectfully contend that the preceding argument by the Examiner is vague and indefinite and thus not persuasive. The Examiner has not provided any unambiguous reason why one of ordinary skill in the art would find it obvious to modify Yamamoto or Yamamoto and Yamashita with Behlen. Accordingly, Applicants contend that the Examiner has not established a *prima facie* case of obviousness in relation to claims 5, 18, 22, and 29.

CONCLUSION

Based on the preceding arguments, Applicants respectfully believe that all pending claims and the entire application meet the acceptance criteria for allowance and therefore request favorable action. If the Examiner believes that anything further would be helpful to place the application in better condition for allowance, Applicants invites the Examiner to contact Applicants' representative at the telephone number listed below.

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